Technical Disclosure Commons

Defensive Publications Series

May 2020

Displaying Occlusions In Augmented Reality

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Displaying Occlusions In Augmented Reality

ABSTRACT

Augmented reality is used to display a view of physical space with virtual 3D objects inserted. When a virtual object is inserted into view in this manner, it can be difficult to determine whether the object fits in the space. Further, users can lose track of the object if it gets occluded by walls or other objects in the space. Per techniques of this disclosure, object boundaries are displayed to indicate whether the object fits in the space. Further, for objects that are hidden in space are displayed using X-ray and cutout shaders. Still further, it is ensured that object selector/footprint and shadow associated with AR objects are shown in a manner consistent with the object. Showing AR objects in this manner provides a consistent and improved user experience.

KEYWORDS

- Augmented reality
- Occlusion
- Object footprint
- Object selector
- Object shadow
- Object size
- Cutout shader
- X-ray shader

BACKGROUND

Augmented reality (AR) is used for many purposes, e.g., to display an augmented view of a user's home where the augmentation includes furniture inserted as it would appear in a

user's home. Such use of AR can provide users with a better idea and greater confidence regarding the size, style and fit of the furniture in their space. However, due to the lack of occlusions with real objects in the room, it is hard for users to know if the AR furniture fits in the space they have. This is because, with current AR techniques, the inserted objects never collide with or get occluded by the real environment.

DESCRIPTION

Per techniques of this disclosure, when a user is translating (e.g., by a move, rotate, or scale operation) an augmented reality (AR) object, occlusions with real environment are represented with an X-Ray shader. This helps the user see if the AR object is colliding with a real object, and therefore doesn't fit in the space. The X-Ray shader representation is optimized to show fit of the object. When the user stops translating the AR object, all the occlusions with the real environment are represented with a cut-out shader. This helps the user see how the objects will look in reality. This also gives an improved sense of perspective to users.

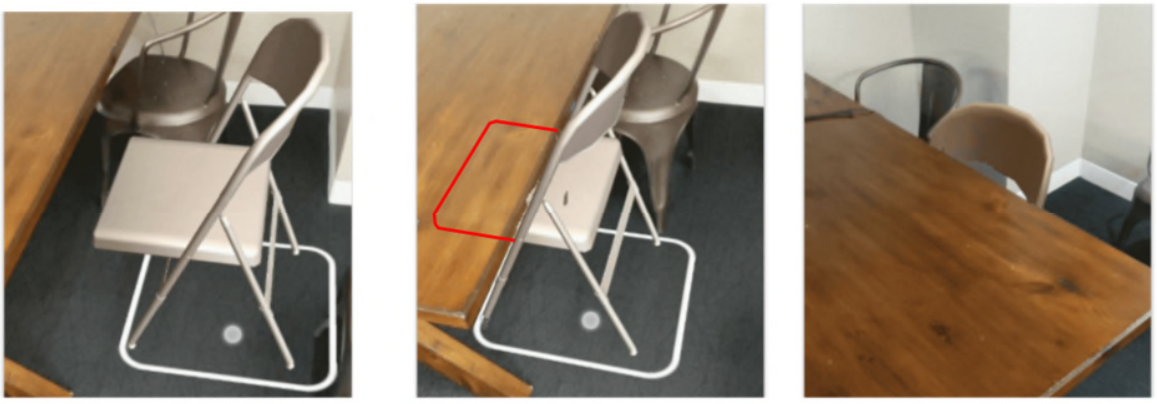
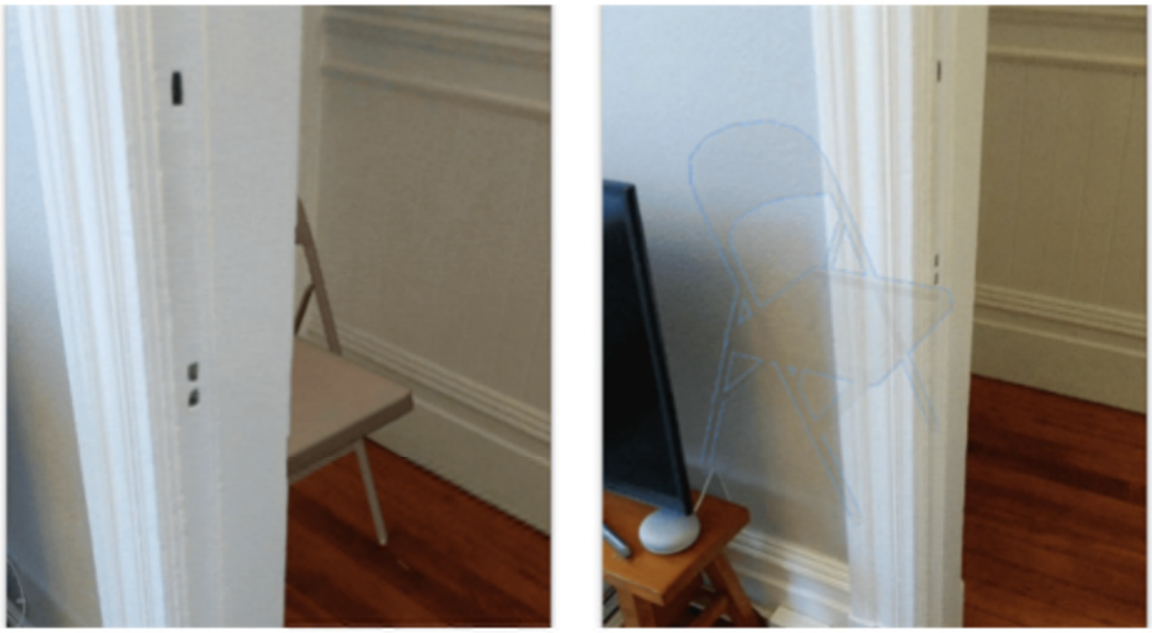


Fig. 1: Object boundaries shown upon occlusion

In some AR views, e.g., when viewing furniture as placed in a user's room, the user may be unsure if the object fits in their space. Per techniques of this disclosure, when a user

manipulates an object, if the object gets occluded by real-world objects, the edges of the object are highlighted upon occlusion to communicate whether the object will fit in the space.

Fig. 1 illustrates an example in which the user is using AR to view a metal chair in their room. The user can use a drag operation to drag the chair in the space. As seen in Fig. 1(a), the user is viewing a metal chair in AR, placed near their desk. When the user drags the chair closer to the desk such that a portion of the chair is occluded by the desk, as seen in Fig. 1(b), the edge of the chair is highlighted (shown in red), providing an indication to the user regarding how the chair fits. The user can then move in the space and view the desk and chair together from a different position, as seen in Fig. 1(c).



(a) (b)

Fig. 2: Objects that are hidden are shown via X-Ray and cutout shaders

Another situation that happens when viewing objects in augmented reality is that an object may be partially or totally occluded by objects in the real world. In such a case, the user may lose track of the object in AR. Fig. 2(a) shows a metal chair that is partially occluded. In

Fig. 2(b), the chair is completely occluded, However, the hidden object is shown (blue outline) in the scene using X-ray and cutout shaders. An off-screen edge indicator can also be used to guide users towards objects in the scene.

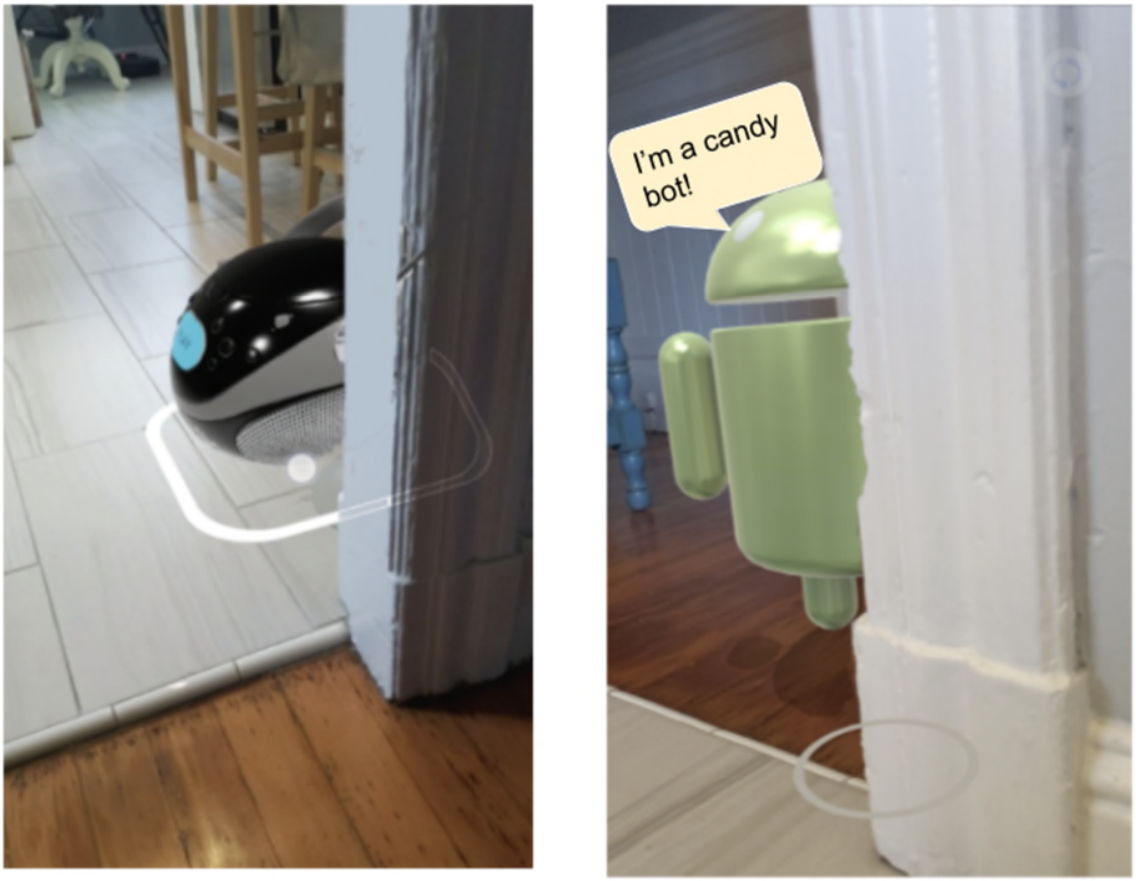


Fig. 3: Object selector and footprint

An inconsistent user experience occurs when an object is occluded but the selector for the object is not occluded. Per techniques of this disclosure, the selector is occluded with a shader that shows the outline of the object. This is illustrated in Fig. 3(a). Showing the outline in this manner enables the user to feel in control of the object even if the object is occluded, partially or totally. Further, with occlusions, it is important that object shadows follow the same

rule as the object. This is illustrated in Fig. 3(b) where the object shadow is occluded and shadows cast against different shapes in the environment.

Occlusion visualization in this manner show whether a 3D object fits in a physical space and enables the user to locate an object if the user loses it behind a wall or another object in the scene. The cutout occlusion visualization provides realism in AR. The visualization technique can also be used for navigational objects, e.g., points of interest in a map.

CONCLUSION

Augmented reality is used to display a view of physical space with virtual 3D objects inserted. When a virtual object is inserted into view in this manner, it can be difficult to determine whether the object fits in the space. Further, users can lose track of the object if it gets occluded by walls or other objects in the space. Per techniques of this disclosure, object boundaries are displayed to indicate whether the object fits in the space. Further, for objects that are hidden in space are displayed using X-ray and cutout shaders. Still further, it is ensured that object selector/footprint and shadow associated with AR objects are shown in a manner consistent with the object. Showing AR objects in this manner provides a consistent and improved user experience.

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